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5.1 CAPITAL WORK

5.1.1 E-820 Bundle Replacement

Ref to S/D IWO BK402-I1
Ref M/R 206613 for the Tubes
Ref M/R 209209 for the Bundle

Replaced titanium bundle in kind (Bundle only, re-used the SS floating head after nubbin removal - see exchanger section, 2.4.2, for details.). Purchased titanium tubes from Tubes, Inc. Had tubes delivered directly to Redman (the BFM for El Segundo) who fabbed the solid titanium fixed and floating tubesheets, and assembled the bundle.

5.1.2 E-825A Channel Replacement with new design

Ref S/D IWO BK403-I1 (no EWO)
Ref M/R 207349 for the Channels

Replaced channel with redesign. Channel and cover clad with 304L, and nozzles overlayed with 309L. Redesign eliminates the interconnecting spool piece, and connects channels A and B directly.

5.1.3 E-825B Channel Replacement with new design

Ref M/R 207349 for the Channels (no EWO)

Replaced channel with redesign. Channel and cover clad with 304L, and nozzles overlayed with 309L. Redesign eliminates the interconnecting spool piece, and connects channels A and B directly. The interconnecting spool between the channels had historically seen high corrosion rates.

Fig 5.1.3: E-825A/B Channels. 304L Clad and redesigned to have directly connected channels, eliminating the funky interconnecting spool (see the shellside spool).

5.1.4 E-826D (Fin-Fan) Replace Bundle

Ref S/D IWO BK408-I1 (no EWO)
Ref M/R 207077 for the Bundle

Replaced fin-fan bundle with upgraded metallurgy to match Units A through C. Header boxes are SA-516 grade 70 CS, and the tubes are 1" 304L SS.

5.1.5 Upgrade Rich DEA Piping from LCV-811 to V-815

Ref S/D EWO BK115-E1 Rev.2

Upgraded approximately 60 linear feet of 8" CS piping (old pipe class, AF9) from LCV-811 to V-815 with 304L SS piping (new pipe class, GF6 without stress relief!). Had to use a short radius elbow immediately downstream of LCV-811 to accommodate the flanged orbit valve that was ordered instead of the appropriate weld-end valve (The purchasing culprit shall remain nameless.). Existing pipe supports were structural beams, but these were not purchased in the stainless variety, so SS pipe dummy legs were used.

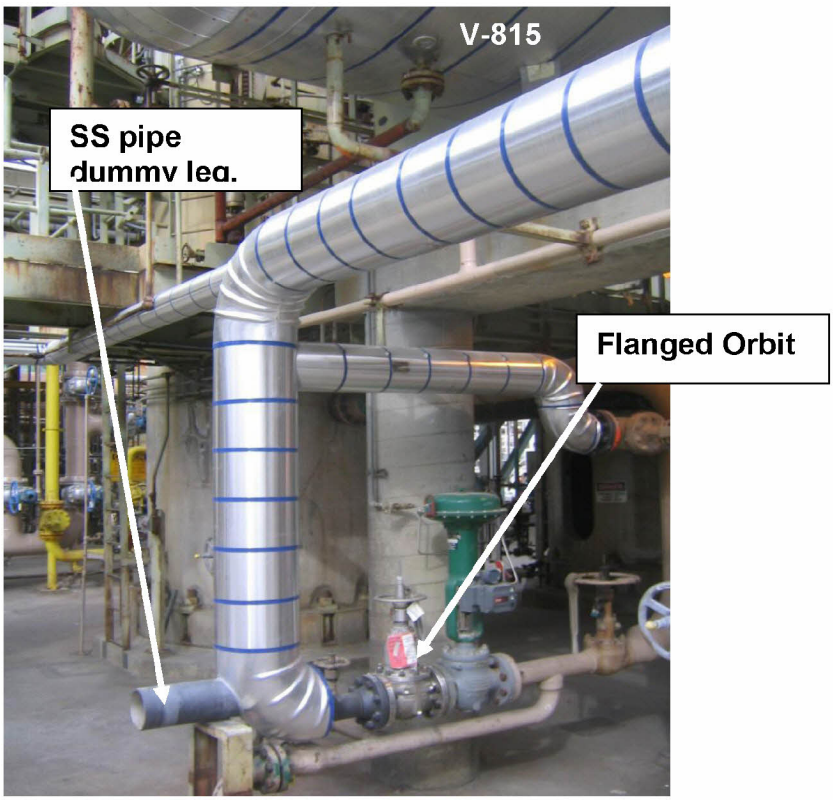

Fig 5.1.5a: Stainless steel piping from LCV-811 to V-815.

The weld on the 8" CS flange that was added on the incoming line from C-860 was stress relieved at 1200F for 1 hour, as required by Rich DEA service above 140F.

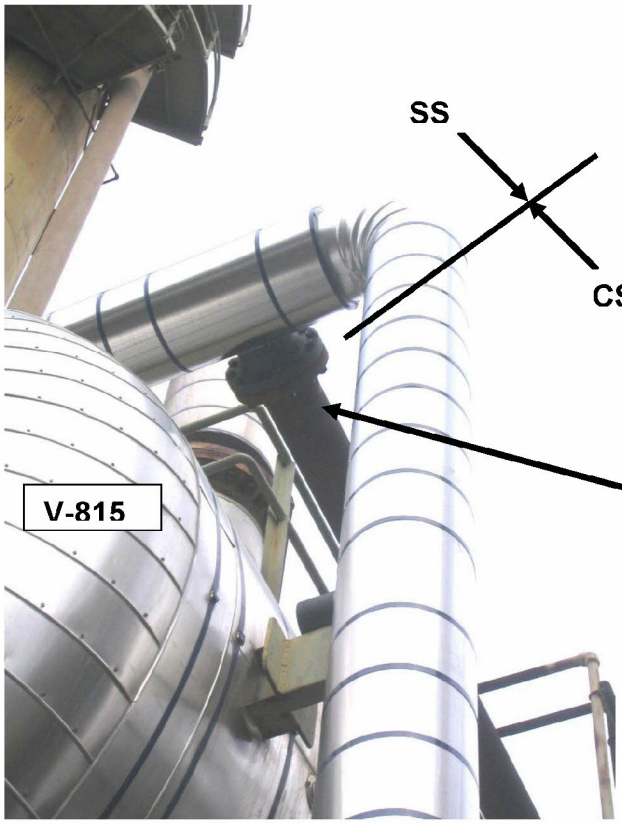

Fig 5.1.5b: Stainless steel piping from LCV-811 to V-815.

NOTE: As far as stress relieving CS in Rich DEA service, the magic number per API has changed from 150F to 140F. Chevron of course has it's own magic number, 100F, for new construction (Refer to section 414 of the CES Corrosion & Materials Manual for complete details). Back in 1974, a design temperature of 149F was chosen for several lines in the Rich DEA system so that stress relief wasn't required. The philosophy for this shutdown was that for any CS lines that operate at or above 140F we definitely stress relieved all new welds, and for CS lines between 100F and 139F, we'd stress relieve if it wasn't too difficult, but it didn't absolutely have to be done (this never really came into play anyway). Attached is a PFD that Process marked up to indicate operating temperatures throughout the DEA system (see attachment 4.4). Also, our pipe class sheets state that stress relief is required in the SS piping (GF6) in Rich DEA service, but this not the case per Materials Engineer, Peter Risse.

5.1.6 Upgrade Rich DEA Piping from V-815 to E-825A

Ref S/D EWO BK116-E1 Rev.2

Upgraded approximately 30 linear feet of 10" CS piping (old pipe class, AF1) from V-815 to E-825A with 304L SS piping (new pipe class, GF6 without stress relief!). Used existing flange location to accommodate the flanged 10" orbit valve that was ordered instead of the appropriate weld-end valve (Again, I'll name no names.).

The weld on the 10" CS flange that was added immediately downstream of the first elbow off of V-815 was stress relieved at 1200F for 1 hour, as required by Rich DEA service above 140F (see note in section 2.1.5 of this report). The 10" CS piping left in the system (just off of V-815) was left as the vessel wasn't entered this shutdown, so we couldn't stress relieve a weld right at the vessel stub. All of the CS left was UT'd to ensure that it could make a 5 year run (report in the EWO binder).

The ¾" CS drain piping to grade (by E-825A) was demo'd, and plugs were inserted in the valves. This was done per Ops request.

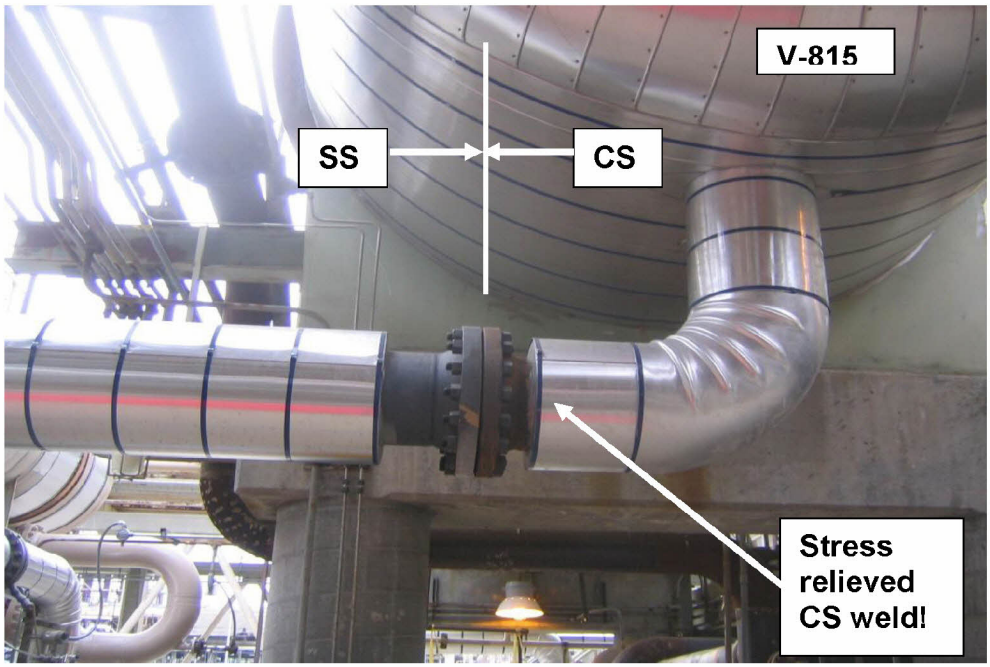

Fig 2.1.6: Carbon steel piping to consider replacing next S/D. Possibly replace with SS back to the vessel stub next opportunity - CS weld will require stress relief.

RECOMMENDATION for FUTURE:

Revisit, and decide on whether or not replace the remaining 10" CS piping all the way to the V-815 stub. CS weld at the vessel stub will require stress relief. If the CS is not replaced, it will require UT to ensure that there is enough metal for another 5 year run.

5.1.7 CCR Tie-in on Sweet Butane Line

Ref S/D EWO BK117-E2 Rev.0

Added a 6" tie-in on the 6" sweet butane line at the plot limit. This tie-in was just added on a section of the line that was being replaced anyway (Ref S/D EWO BK117-E1 & BK117-E3 Rev 2, and section 5.2.4 of this report). The tie-in has two 6" Orbit valves and an intermediate bleeder.

5.1.8 Replace Undersized PSV-011 (C-810) with Larger PSV

Ref S/D EWO BK124-E1 Rev.2

Per the D&R Relief Study, PSV-011 was undersized, and needed to be upsized from a 3" x 4" to a 4" x 6". The associated inlet and outlet piping had to be replaced to/from the headers as well.

5.1.9 Replace Undersized PSV-031 (C-830) with Larger PSV

Ref S/D EWO BK125-E1 Rev.1

Per the D&R Relief Study, PSV-031 was undersized, and needed to be upsized from a 1.5" x 3" to a 3" x 4". The associated inlet and outlet piping had to be replaced to/from the headers as well.

NOTE: The orbit valve at FT-839 is a CL300 to accommodate the instrument, so the flange on the AB0 piping needs to be CL300 to match – we got this wrong the first time, as there is no access OTR, and the drawing didn't call out the pipe class break. The P&ID has been updated to reflect the pipe class break.

5.1.10 Replace Undersized PSV-071 (V-870) with Larger PSV

Ref S/D EWO BK126-E1 Rev.0

Per the D&R Relief Study, PSV-071 was undersized, and needed to be upsized from a 6" x 8" to a 6" x 10". The associated outlet piping and isolation Knife Gate immediately downstream of the PSV had to be replaced as well. The new 10" Knife Gate is 304SS with AFLAS Flouroelastomer seat, and Teflon Graphite Packing.

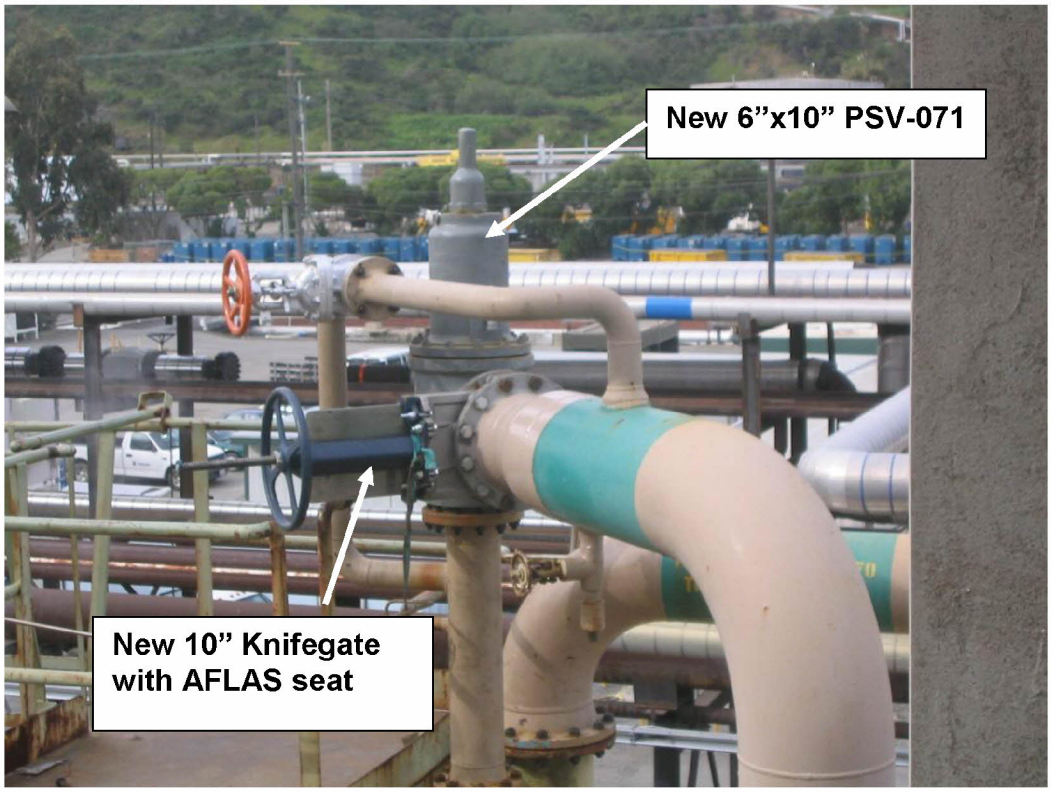

Fig 5.1.10: New upsized PSV on V-870 with new 10" Knife Gate Valve.

5.1.11 Modify piping for new Larger Control Valve FC-023

Ref S/D EWO BK130-E1 Rev.0

Modify the spools on the inlet and outlet side of FC-023 to accommodate new 10" control valve. Spools are 304L SS (GF6 without stress relief!).

5.1.12 Modify piping for new Larger Control Valve PV-027

Ref S/D EWO BK131-E1 Rev.0

Modify the piping on the inlet and outlet side of PV-027 to accommodate new 12" control valve.

5.1.13 Modify piping for new Larger Control Valve PV-012

Ref S/D EWO BK132-E1 Rev.0

Modify the spools on the inlet and outlet side of PV-012 to accommodate new 12" control valve. The bypass piping was also increased from 10" to 12".

5.1.14 LP Condensate Tie-Ins for GHT

Ref S/D EWO BK133-E1 Rev.1

Added 6" LP Condensate tie-in at the plot limit for the future GHT Plant.

5.1.15 Sweet Gas to SMR and Process Gas Balance Line Tie-ins

Ref S/D EWO BK134-E1 Rev.3

Added a new spool with two 12" connections and an intermediate block valve just downstream of PV-012, to allow for the future diversion of sweet gas to the SMR, and process gas return from PSA3.

Added 12" connection at the plot limit for the future Process Gas Balance Line. This is the big 12" U at the plot limit (see fig 5.1.15b).

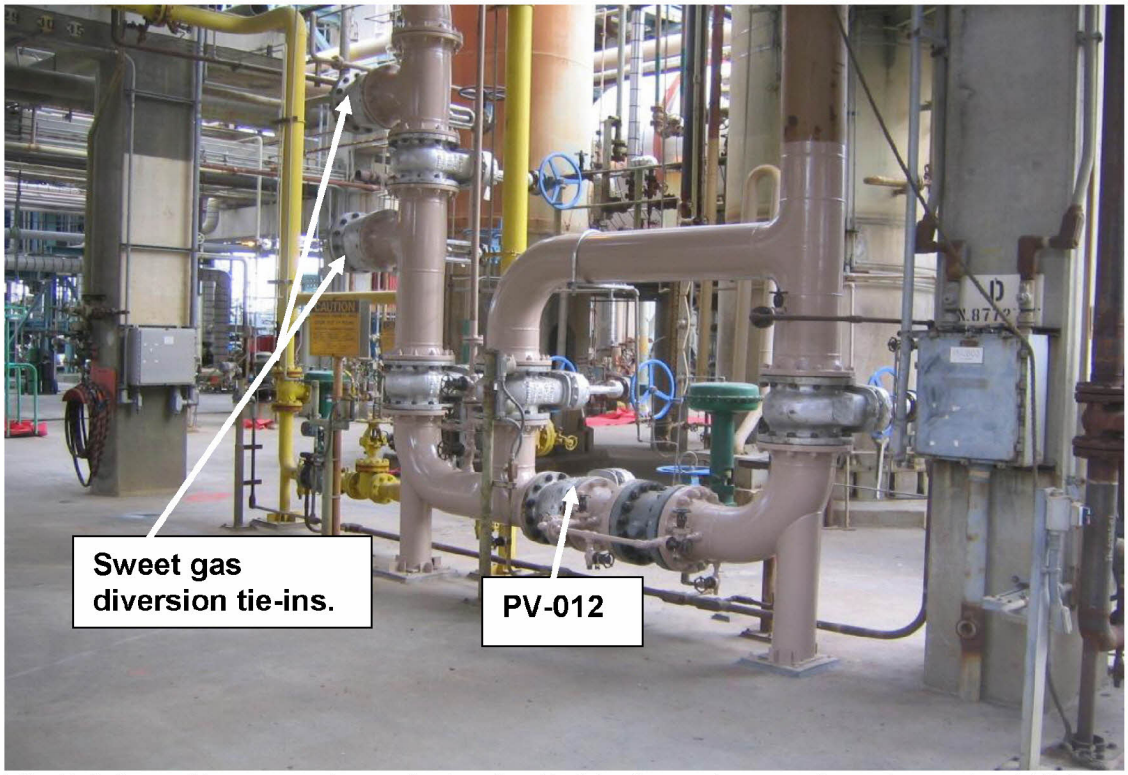

Fig 5.1.15a: New sweet gas tie-ins for SMR, downstream of newly upsized PV-012. Isn't that a nice paint job!

Fig 5.1.15b: New 12" tie-in at the plot limit for the future Process Gas Balance Line.

5.1.16 CCR Tie-in in the Fuel Gas System

Ref S/D EWO BK135-E1 Rev.0

Added a new 12" branch connection in the Fuel Gas header to provide fuel gas to the future CCR. A Twin Seal valve was installed at the tie-in point.

5.2 PIPING

5.2.1 Process Valves

Ref S/D EWO BK102-E1 Rev.3
Ref S/D EWO BK102-E2 Rev.0
Ref S/D EWO BK102-E3 Rev.2
Ref S/D EWO BK102-E4 Rev.0
Ref S/D EWO BK102-E5 Rev.0
Ref S/D EWO BK102-E6 Rev.0

In 5H2S, forty-two valves were replaced or repaired per EWO's.

ONE VALVE WORTH MENTIONING:

5H2S Relief Isolation Valve (at Plot Limit) was replaced:
Ref S/D EWO BK102-E1 Rev.3
Ref S/D EWO BK102-E4 Rev.0
Ref M/R 212522 for Knife Gate Valve
Valve was tagged GV-0122

This is a 14" Fabri-Valve Knife Gate. The job was originally planned as a fresh-air swap out, but that idea was canned last minute due to safety concerns. Ops and Maintenance Management did not want to perform "live relief" job with a 14" valve (Live relief jobs are generally limited to 2" and below.). Instead, the job was completed using an awesome 14" Freeze Plug to isolate the job from relief (Ref S/D EWO BK102-E4 Rev.0, compliments of Design Engineer Pat Murphy.). The new valve is 304SS with AFLAS Flouroelastomer seat, and Teflon Graphite Packing.

Fig 5.2.1: New 5H2S Relief Isolation Valve at the plot limit.

RECOMMENDATIONS for FUTURE Process Valve Work:

Identify HydroStatic test boundaries exactly and identify them on the EWO.

Evaluate HydroStatic test pressures. When testing against anything other than blinds, including new or existing valves, lower test pressures below those indicated by Piping Classifications. Consider system PSV settings, valve packing limitations, service, etc.

5.2.2 Install flanges on Relief Valve C5-18

Ref S/D EWO BK104-E1 Rev.0

Added ¾" nipple and CL300 Flange to inlet, and 1" nipple and CL150 Flange to outlet of relief valve, as the valve has non-standard dimensions. Tried to get Swan to assemble to required dimensions, but that was a no go - so we just ordered a threaded valve and added the flanges ourselves.

5.2.3 Miscellaneous Temporary Piping

Ref S/D EWO BK108-E1 Rev.0

Installed temporary piping to accommodate shutdown needs.

5.2.4 Replaced corroded Sweet Butane Line

Ref S/D EWO BK117-E1 Rev.0
Ref S/D EWO BK117-E3 Rev.2

Replaced in-kind approximately 100 linear feet of 6" CS piping at the plot limit. Flanges were added to permit hydrotesting. Rev 2 extended the southern-most boundary for replacement an additional 40 linear feet (up into the pipeway south of the plot limit) due to CUI. A Capital Projects CCR Tie-in was also included on this section of pipe (Ref S/D EWO BK117-E2 and section 2.1.7 of this report.).

5.2.5 Replaced 6" ell on Rich DEA Line (at plot limit)

Ref S/D EWO BK118-E1 Rev.1

Replaced mechanically damaged ell - while cutting cookie holes for inspection, they inadvertently drilled into the pipe to about half wall. The welds on this CS line required stress relief per Rich DEA above 140F (see note in section 2.1.5 of this report).

5.2.6 Replaced Swage to Lean DEA Sample Cooler

Ref S/D EWO BK119-E1 Rev.1

Replaced in-kind CS swage that was screwed into SS cooler. These details were left off of the original EWO, and the existing swage (along with some of the cooler that it was screwed into) were cut off, and not very cleanly. The cooler threads were cleaned up, and a new swage was threaded in, but the piping had to be adjusted ever so

slightly to allow proper fit up. All CS to CS welds were stress relieved per AF9. The CS to SS seal weld was not stress relieved.

5.2.7 Replace internally corroded piping at V-899

Ref S/D EWO BK120-E1 Rev.0

Replaced about 10 linear feet of 2" piping at V-899. Added a new isolation orbit valve to eliminate dead leg exposure to process and reduce/eliminate cause of corrosion.

5.2.8 Replace E-825A/B Shellside interconnecting spool with 304L SS Upgrade

Ref S/D EWO BK123-E1 Rev.0

Replaced about 10" shellside interconnecting spool with 304L SS upgrade. The SS spool was actually made for the E-825 channels, but they were redesigned to be connected directly. The thermowell location on the new spool is incorrect (as it was made for the channels), so the flow is away from the TI, instead of towards it, but this was acceptable to the process folks. The CS spacer between the spool and E-825A shell was reused.

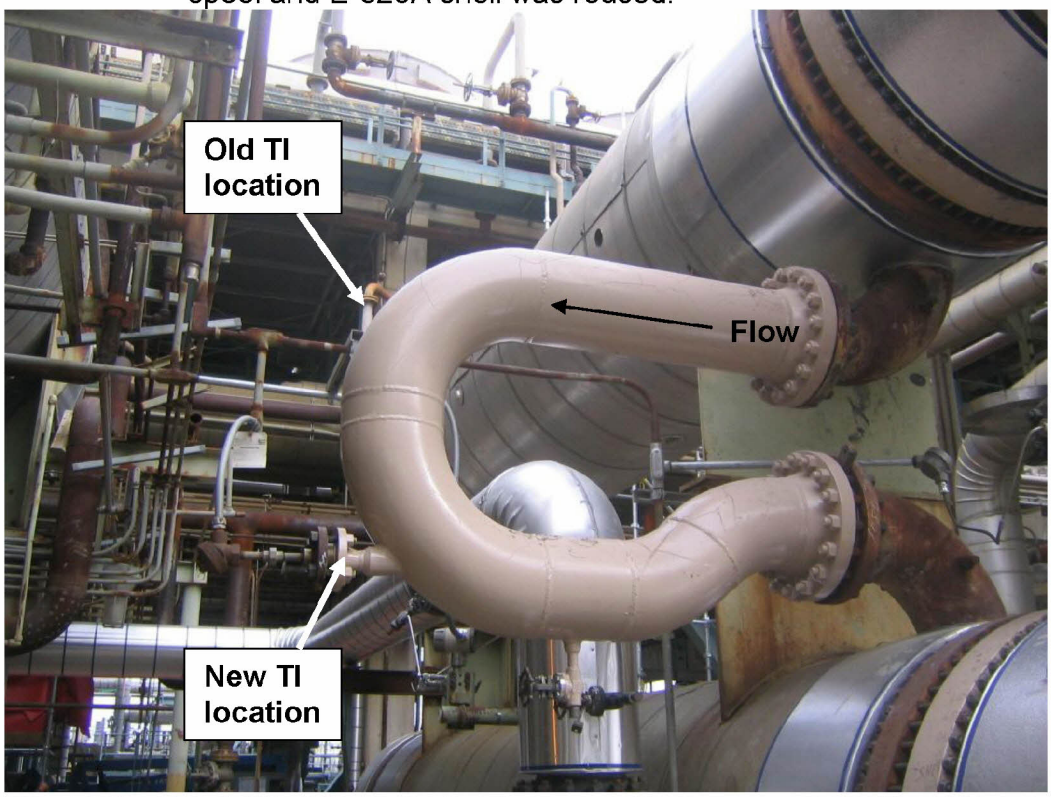

Fig 5.2.8: New 304L SS shellside interconnecting spool on E-825's. The spool was designed for the channels, so the TI is not exactly where we'd like it, but that's what we've got.

5.2.9 Replace V-815 Instrument Piping

Ref S/D EWO BK127-E1 Rev.1
Ref S/D EWO BK137-E1 Rev.0

Replaced in-kind 2" piping to LG-813 and LT-813 on V-815. New piping was stress relieved as required by Rich DEA service above 140F (see note in section 2.1.5 of this report). The ½" vent on top of LT-813 was left ½" because I was new, and I'm a retard, and I didn't know to replace it with a ¾" vent. RO plates on the gage glass piping were lost and had to be re-ordered.

Also replaced in-kind 2" piping to LG-814. New piping was stress relieved as required by Rich DEA service above 140F (see note in section 2.1.5 of this report). RO plates were of course lost and re-ordered.

RECOMMENDATION for FUTURE:

Take pictures of the existing piping with the RO plates installed, so that in the heat of battle, when the contractor says, "There were no RO's there!", you can say, "Yes there were, I have pictures!". I found that very helpful this time around.

Definitely remind the piping contractor before hand that the RO's are going to be re-used, so they should take the necessary steps to make sure that none are lost.

5.2.10 Replace V-815 Drain Piping to Sewer

Ref S/D EWO BK128-E1 Rev.0

Replaced in-kind 2" drain piping to grade (on the south end of V-815). New piping was stress relieved as required by Rich DEA service above 140F (see note in section 2.1.5 of this report).

5.2.11 Replace piping downstream of FCV-034 at C-830

Ref S/D EWO BK136-E1 Rev.0

Replaced in-kind about 30 linear feet of 1.5" stripped sour water piping to C-830 due to CUI. Mitigated the problem by leaving the piping uninsulated – none required for service or ppe, I don't know why it was insulated to begin with.

5.2.12 Replace two flanges on the Sweet Butane Line

Ref S/D EWO BK138-E1 Rev.0

Replaced in-kind a 4" AF1 flange at the plot limit, and a 1.5" AF1 flange by V-870. Flanges were "discovered" bad while replacing the valves that bolt to them.

5.2.13 Replace 150# Steam piping due to CUI

Ref S/D EWO BK139-E1 Rev.0

Replaced in-kind two sections of 2" steam piping, and one section of 1" steam piping due to CUI. Coated piping per Chevron Coating Data Sheet 12.1 to mitigate the CUI problem.

5.2.14 Modify ¾" Drain line from E-800 to V-800

Ref S/D EWO BK140-E1 Rev.0

Demo'd ¾" drain piping from 12" sour gas line to relief system per Ops request (plugging problems). Provided a block valve and flange pair for future piping needs.

5.3 COLUMNS / VESSELS

5.3.1 C-810 H2S Absorber

Ref S/D IWO BK301-I1 (no EWO)

Shell: All good.

Nozzles: All good.

Trays:

Trays 1-25 (CS): All good.

Distributors: All good.

Vortex Breaker:

Replaced one of the clips on the vortex breaker, as it had a crack in it.

5.3.2 C-820 DEA REgenerator

Ref S/D EWO BK302-E1

This column was added to the worklist as a result of an ROI study. It was determined that tray fouling was of concern, and that it has historically caused unplanned shutdowns.

Shell: All good.

Nozzles: All good.

Trays:

Tray 1 (304L SS): All good.

Trays 2-17 (CS): All good.

Trays 18 & 19-22 (304L SS): Downcomers and downcomer supports required some "beat to straighten" action, but aside from that and a layer of scale, these trays were in pretty good shape.

Distributors:

Reflux Distributor (S12): Installed with the holes pointing in the wrong direction last shutdown (they were pointed down and in towards the center of the column). Rotated 90° so that holes are pointed in the correct direction (down and out towards the wall). The distributor is floating off of one of the cradles intended to support it – decided to leave it as is.

DEA Inlet Distributor (S11): All good.

Vortex Breaker: All good.

RECOMMENDATION for FUTURE:

Inspect the reflux distributor to make sure that it is still in good repair, and possibly reattach to support cradle if needed.

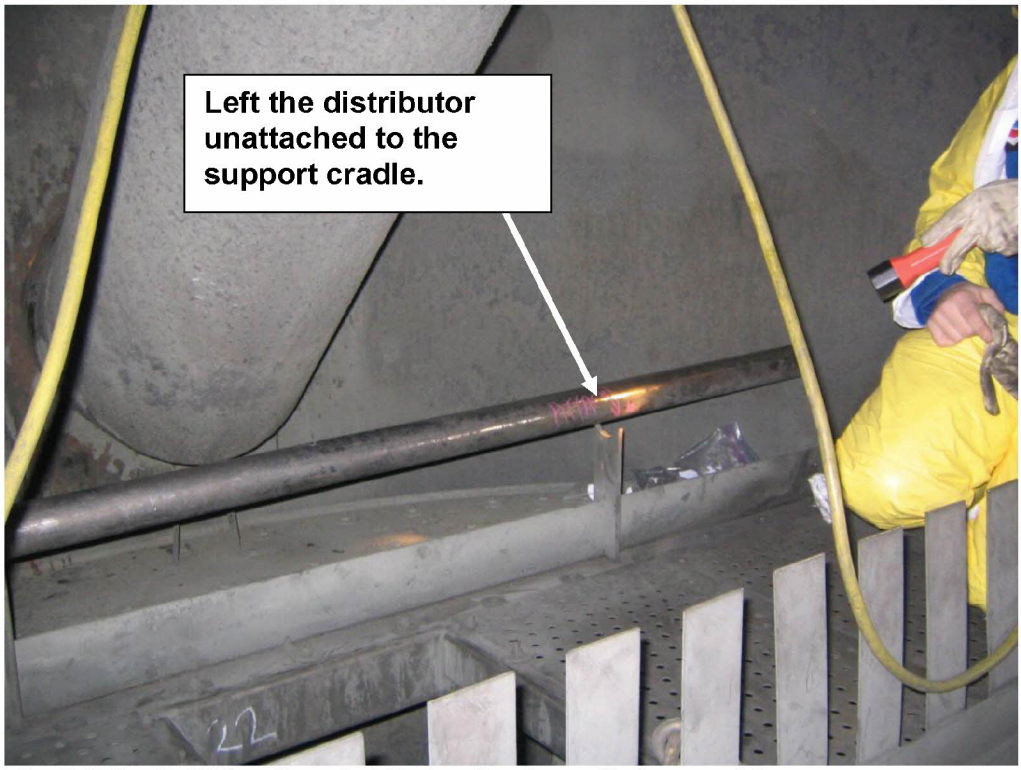

Fig 5.3.2: C-820 reflux distributor floating off of one of the support cradles. We decided that we were OK with that.

5.3.3 C-830 Ammonia Scrubber

Ref S/D EWO BK303-E1
Ref S/D EWO BK303-E2
Ref M/R 208665 for Pall Rings
Ref M/R 202956 for Demister Pad

Shell: All good.

Nozzles: All good.

Packed Beds:

Packing and supports removed for inspection. Replaced 20% of the packing in-kind, and re-used 80%.

Distributors: All good.

Dimister Pad: Replaced with new pad per M/R 202956.

Vortex Breaker: All good.

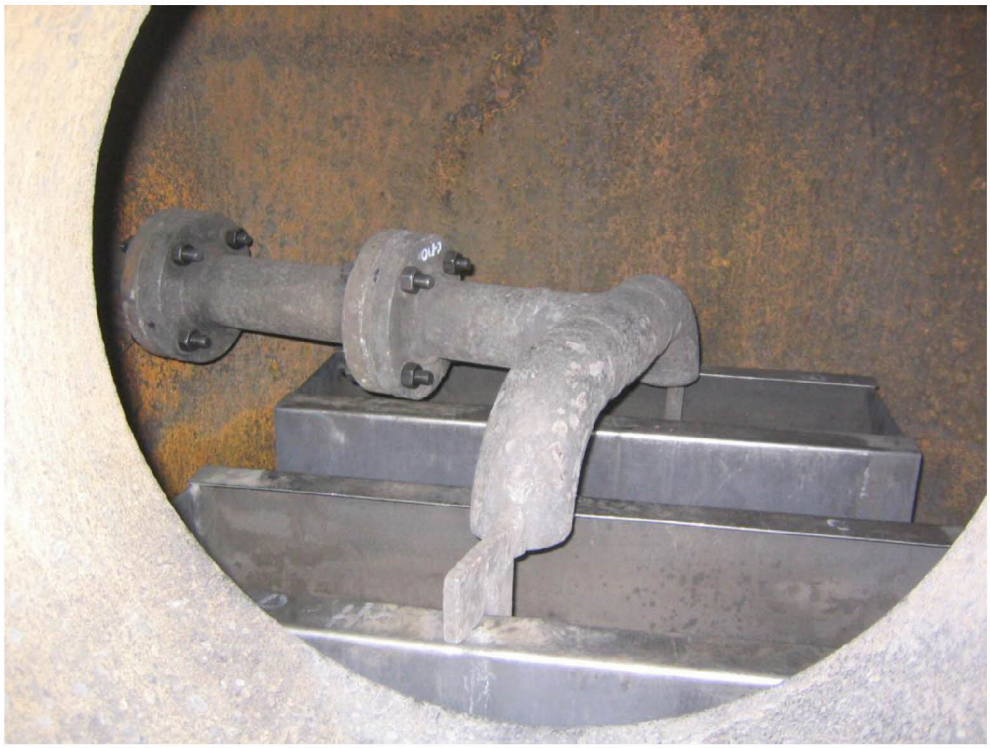

Fig 5.3.3a: C-830 liquid inlet distributor and wier trough distributors at S6. Ron would disapprove of the single nuts, but that's how it was for the last 10 years, and it held up just fine – the nuts get a layer of scale deposited on them anyway, so they aren't going anywhere.

Fig 5.3.3b: New demister pad installed in C-830. Viewed from M5.

5.3.4 C-840 Emergency Scrubber

Ref S/D IWO BK304-I1 (no EWO)

Shell: All good.

Nozzles: All good.

Trays: All good. Andrew Corson and Brian Scaief were kind enough to tunnel the upper trays – I'd have gotten stuck in that thing.

Distributors: All good.

Vortex Breaker: All good.

5.3.5 C-860 Butane Contactor

Ref S/D EWO BK305-E1 Rev.0 (not done!)
Ref S/D EWO BK305-E2 Rev.0
Ref S/D EWO BK305-E3 Rev.1
Ref S/D EWO BK305-E4 Rev.0
Ref M/R 202467 for Belzona 1591 (not used!)

Shell:

Weld repaired a total of 5 locally thinned areas on the shell of the column. There was one planned weld build at M2 (ref S/D EWO BK305-E3 Rev.1), and four other discovery weld build locations - one on circumferential weld 4, and three on circumferential weld 6 (ref S/D EWO BK305-E4 Rev.0). All weld builds required Hydrogen Bakeout at 450F min to 600F max for a minimum of four hours, and full circumferential band PWHT at 1150F for a minimum of one hour.

At the current corrosion rate, two of the locations on circumferential weld 6 could have made a 10 year run, but because we had to stress relieve the entire circumferential band anyway, we went ahead and repaired them as well.

The planned weld repair (BK305-E3 Rev.1) was done at a locally thinned area identified in 2000, at which time it was coated with Belzona 1591, and a Fitness For Service (FFS) evaluation was completed. The Belzona coating held up extremely well (see Fig 2.3.5b).

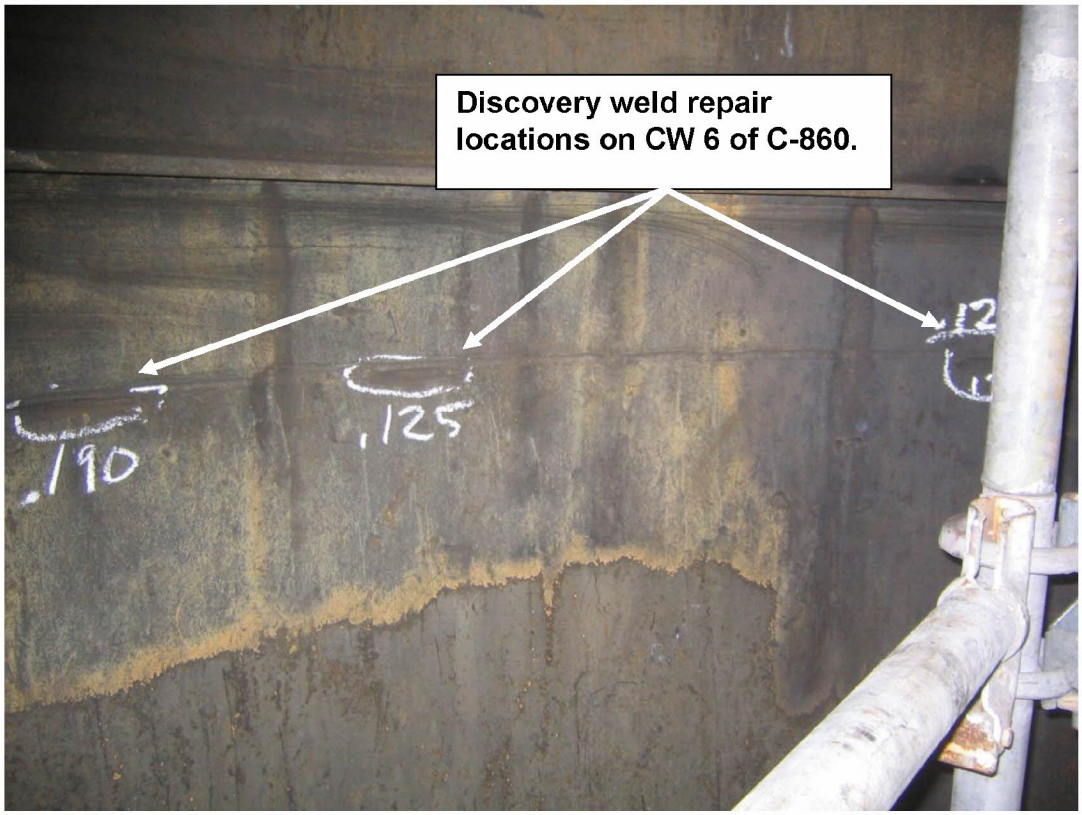

Fig 2.3.5a: Three discovery weld repair areas on circumferential weld 6. At current corrosion rates, the 0.125" deep indications could have made a 10 year run, but since we had to stress relieve the entire circumferential band anyway, we just went ahead and repaired them as well.

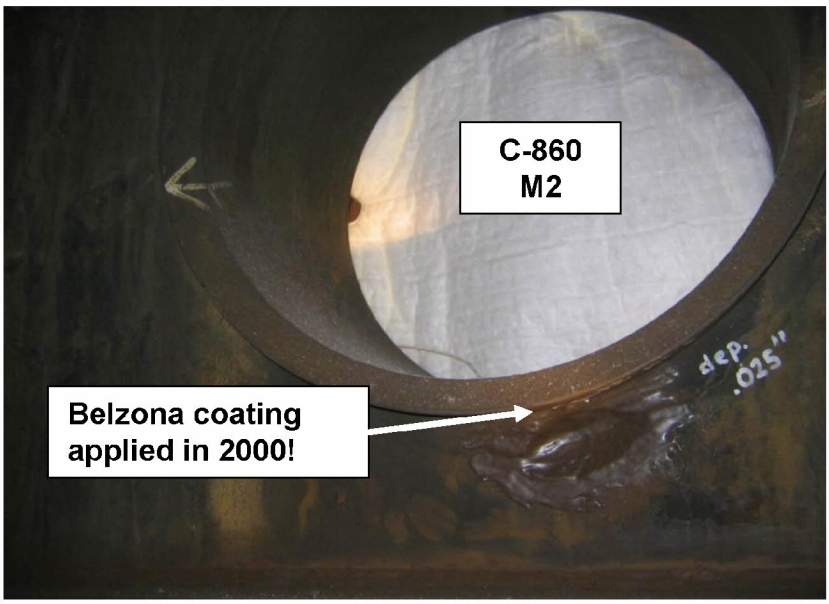

Fig 2.3.5c: Belzona coating on FFS area under M2 on C-860 held up remarkably well for 6 years. The coating was ground out, and the shell was weld repaired this shutdown.

In addition to the 5 locations that were repaired this time around, there were other indications that were not addressed this shutdown. We determined that these indications could make a 10 year run, and they didn't happen to be at elevations coinciding with a mandatory repair (i.e. there are 3 indications at CW 5 that weren't welded on this time).

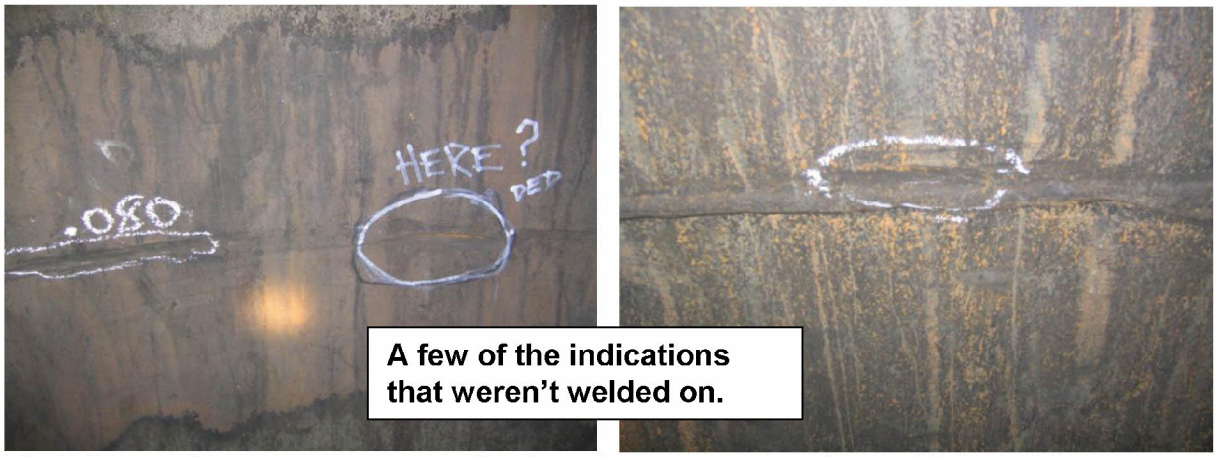

Fig 5.3.5c: There were several indications that were not addressed this shutdown, as it was determined that they could make a 10 year run. Have a contingency plan to possibly make some repairs the next time the column is entered.

Nozzles: All good.

Packed Beds:

Packing and supports removed for inspection. Replaced 20% of the packing in-kind, and re-used 80%.

Distributors:

Sour C4 Inlet Distributor (S3): The distributor was severely plugged with an almost coke-like material. The distributor was removed, unplugged and cleaned this shutdown.

DEA Inlet Distributor (S5): All good.

Vortex Breaker: All good.

Fig 5.3.5d: Severely plugged sour butane inlet distributor (at S3) was removed and unplugged/cleaned.

RECOMMENDATION for FUTURE:

Revisit the decision about whether or not to coat all internal welds with Belzona 1591 in order to mitigate the stress corrosion cracking issues that exist in this column (ref S/D EWO BK305-E1 for Belzona coating – this work was not done this shutdown).

Consider Belzona 1591 as a possible alternative contingency plan to weld build/stress relief next time – use the fact that the Belzona applied to the FFS location under M2 held up extremely well for 6 years as support for this plan of action.

Be prepared to weld build/stress relieve due to stress corrosion cracking at the welds in the column. There were several indications (3 at circumferential weld 5, for instance) that were not repaired this time around. Refer to EWO's BK305-E3 and E4 for details concerning stress relief and preparing the column for thermal growth.

Fig 5.3.5e: What to expect if weld build is required - all kinds of fun!

5.3.6 V-811 Sweet Gas Portatest Seperator

Ref S/D EWO BK307-E1 Rev.0

The 6" recycle line had a level of liquid/sludge stuck in the bottom of it, as did the vortex breaker. This was cleaned out. Otherwise, the vessel looked to be in good repair.

5.3.7 V-860 Overhead Receiver

Ref S/D IWO BK315-I1 (no EWO)

Opened, hydroblasted, completed API 510 Inspection – all good.

5.3.8 V-870 Fuel Gas Mix Drum

Ref S/D EWO BK316-E1 Rev.0
Ref M/R 202976 for Demister Pad

Replaced the demister pad. Anticipated weld repair on the top head, but Inspection found nothing of note. The overlay on the bottom head still looks good.

5.3.9 V-899 Relief Drum

Ref S/D EWO BK317-E1 Rev.0

Completed API 510 Inspection. Replaced mangled vortex breaker. Everything else looked good.

5.3.10 D-852 Stripped Water Break Tank

Ref S/D IWO BK321-I1 (no EWO)

Opened, inspected – all good. Bursting disc was in like new condition. Bursting disc is storehouse stock.

5.4 HEAT EXCHANGERS

All Heat Exchanger Data was reviewed and update for all the exchanger during this Shutdown. Any gasket changes and torque procedure revisions were documented in the 2 binders labeled D&R 1Q 2007 S/D Heat Exchanger Gasket Info and Updates.

5.4.1 E-800 Sour Gas Cooler (Fin Fan)

Ref S/D IWO BK401-I1 (no EWO)

Removed 40 plugs, hydroblasted and ET inspected – all good.

5.4.2 E-820 Overhead Condenser

Ref S/D EWO BK402-E1 Rev.0
Ref S/D EWO BK402-E2 Rev.0

Replaced titanium bundle in kind (Refer to section 2.1.1 of this report for details.). Removed nubbin from floating head flange (ref S/D EWO BK402-E1 Rev.0).
Weld repaired two gouges on the shell flange gasket surface – on the channel side of the shell (ref S/D EWO BK402-E2 Rev.0)

RECOMMENDATION for FUTURE:

When the shell nears end of life, evaluate a redesign to put cooling water on the tubeside. The shell was replaced January 2001, and the bundle was replaced this shutdown, January 2007. However, the Titanium bundle has a history of embrittlement due to high temperatures. Shell life will most likely drive the timing of this redesign "opportunity". Contact Corporate Heat Exchanger Specialist, R.P. Hohmann when this "opportunity" arises.

5.4.3 E-825A Lean/Rich DEA Exchanger

Ref S/D EWO BK403-E1 Rev.0

Replaced channels with re-design (see section 2.1.2 of this report for details). Removed nubbin from floating head (ref S/D EWO BK403-E1 Rev.0).
There was a layer of scale on the exterior surface of the tubes that didn't come off with hydroblasting. PED evaluated and decided that they were fine as is.
Shell outlet nozzle was thought to potentially need weld repair prior to shutdown, but inspection determined that none was required.

5.4.4 E-825B Lean/Rich Exchanger

Ref S/D EWO BK404-E1 Rev.0

Replaced channels with re-design (see section 2.1.3 of this report for details). Removed nubbin from floating head (ref S/D EWO BK404-E1 Rev.0).
There was a layer of scale on the exterior surface of the tubes (lean DEA service) that didn't come off with hydroblasting. PED evaluated and decided that they were fine as is.

5.4.5 E-826C Lean DEA Cooler

Ref S/D IWO BK407-I1 (no EWO)

Removed 10% of header plugs, hydroblasted and ET inspected – all good.

5.4.6 E-826D Lean DEA Cooler

Ref S/D IWO BK408-I1 (no EWO)

Replaced bundle with tube upgrade to 304L SS to match units A through C (see section 2.1.4 of this report for details).

5.4.7 E-827A DEA Regenerator Reboiler

Ref S/D EWO BK409-I1 (no EWO)

Opened, hydroblasted and ET tested 10% of tubes – all good.
There was a layer of scale on the exterior surface of the tubes (DEA service) that didn't come off with hydroblasting. PED evaluated and decided that they were fine as is.

5.4.8 E-843 Aqua NH3 Cooler (Double Pipe)

Ref S/D EWO BK415-E1 Rev.0

Opened, ET inspected all tubes, and plugged 12 tubes. Had process folk's permission to plug up to 100%, but no more than that.

RECOMMENDATION for FUTURE:

Consider removing from service as the inlet ammonia is cooler then the cooling water used to cool it, so these are actually functioning as heaters.
If not removing from service, consider having a replacement bundle on hand, as 15 tubes had greater than 40% wall loss, and several others were untested as they were too dirty/plugged for a reading.

5.4.9 E-843A Aqua NH3 Cooler (Double Pipe)

Ref S/D EWO BK415-E1 Rev.0

Opened, ET inspected all tubes, and plugged 2 tubes. Had process folk's permission to plug up to 100%, but no more than that.

RECOMMENDATION for FUTURE:

Consider removing from service as the inlet ammonia is cooler then the cooling water used to cool it, so these are actually functioning as heaters.
If not removing from service, consider having a replacement bundle on hand, as 5 tubes had greater than 40% wall loss, and many others were untested as they were too dirty/plugged for a reading.

5.4.10 E-845 Bottoms Circulation Cooler

Ref S/D IWO BK417-I1 (no EWO)
Ref S/D IWO BK417-I2 (no EWO)

Pulled 20 header plugs, hydroblasted and ET inspected – all good. Had to chase threads on 4 header plugs.

5.5 FUTURE SHUTDOWN RECOMMENDATIONS

5.5.1. PIPING

Process Valves

Identify HydroStatic test boundaries exactly and identify them on EWO.

Evaluate HydroStatic test pressures. When testing against anything other than blinds, including new or existing valves, lower test pressures below those indicated by Piping Classifications. Consider system PSV settings, valve packing limitations, service, etc. Aggressively pursue in-service testing of some systems.

On large S/D's dedicate one Engineer to own and follow this valve work before and during execution. We did this on this shutdown, and it seemed to work well (at least for those of us that weren't the valve guy!)

Rich DEA SS Piping Upgrade by V-815:

Revisit, and decide on whether or not to replace the remaining 10" CS piping all the way to the V-815 stub. CS weld at the vessel stub will require stress relief. If the CS is not replaced, it will require UT to ensure that there is enough metal remaining for a 5 year run.

Instrument Piping – Sight Glasses

Take pictures of the existing piping with the RO plates installed, so that in the heat of battle, when the contractor says, "There were no RO's there!", you can say, "Yes there were, I have pictures!". I found that very helpful this time around.

Definitely remind the piping contractor before hand that the RO's are going to be re-used, so they should take the necessary steps to make sure that none are lost.

DEA Piping - General

Use the attached PFD (Attachment 5.6.4) to evaluate PWHT requirements for future piping replacements.

5.5.2 COLUMNS

C-820 DEA Regenerator

Inspect the reflux distributor to make sure that it is still in good repair, and possibly reattach to support cradle if needed.

C-860 Butane Contactor

Revisit the decision about whether or not to coat all internal welds with Belzona 1591 in order to mitigate the stress corrosion cracking issues that exist in this column (ref S/D EWO BK305-E1 for Belzona coating – this work was not done this shutdown).

Consider Belzona 1591 as a possible alternative contingency plan to weld buid/stress relief next time – use the fact that the Belzona applied to the FFS location under M2 held up extremely well for 6 years as support for this plan of action.

Be prepared to weld build/stress relieve due to stress corrosion cracking at the welds in the column. There were several indications (3 at circumferential weld 5, for instance) that were not repaired this time around. Refer to EWO's BK305-E3 and E4 for details concerning stress relief and preparing the column for thermal growth.

5.5.3 HEAT EXCHANGERS

E-820 Overhead Condenser

When the shell nears end of life, evaluate a redesign to put cooling water on the tubeside. The shell was replaced January 2001, and the bundle was replaced this shutdown, January 2007. However, the Titanium bundle has a history of embrittlement due to high temperatures. Shell life will most likely drive the timing of this redesign "opportunity". Contact Corporate Heat Exchanger Specialist, R.P. Hohmann when this "opportunity" arises.

E-843 Aqua NH3 Cooler

Consider removing from service as the inlet ammonia is cooler then the cooling water used to cool it, so these are actually functioning as heaters.

If not removing from service, consider having a replacement bundle on hand, as 15 tubes had greater than 40% wall loss, and several others were untested as they were too dirty/plugged for a reading.

E-843A Aqua NH3 Cooler

Consider removing from service as the inlet ammonia is cooler then the cooling water used to cool it, so these are actually functioning as heaters.

If not removing from service, consider having a replacement bundle on hand, as 5 tubes had greater than 40% wall loss, and many others were untested as they were too dirty/plugged for a reading.

5.6 ATTACHMENTS

5.6.1 5H2S PRE-SHUTDOWN PROPOSED WORKLIST

Attached is the pre-S/D worklist. This may be a helpful aid in understanding the decisions made about certain equipment's or tasks.

5H2S Pre-Shutdown Worklist

5.6.2 FINAL 5H2S WO LOG

Attached is the final WO Log. This may be a helpful aid in understanding at a glance just what really did go down this time around.

5H2S WO Log

5.6.3 SHUTDOWN PLUS/DELTA

Attached is the un-edited record of an unofficial Plus / Delta session involving many participants, however all players were not involved. This must be considered unofficial and preliminary.

[ATTACH WHEN AVAILABE]

5.6.4 5H2S PFD MARKED W/DEA OPERATING TEMPS

Attached is a PFD marked with DEA operating temperatures. This may be helpful in determining which CS lines require stress relief.

DEA Operating Temps

5.6.5 5H2S CONTINGENCY PLANNING FILES

Attached is a link to the 5H2S Contingency Planning files on the O:drive.
We shouldn't have to re-invent the wheel every 5 years.

Link to 5H2S Contingency Files

[UPDATE LINK WHEN FILE LOCATION FINALIZED]